

## Metal Rubber Sensor Appliquis for Rotor Blade Air, Phase II

Completed Technology Project (2009 - 2012)



## Project Introduction

Thin film Metal Rubber<sup>TM</sup> sensor appliquéés have the potential to reduce the time, complexity and cost of measuring air flow-induced skin friction during the development of rotary wing and fixed wing aircraft and related systems. Metal Rubber

TM

skin friction sensor appliquéés allow near real-time detection 2D mapping of air flow conditions over surfaces of air vehicles. This is important for analysis of laminar to turbulent flow transitions, flow separation and reattachment mechanisms, and other instabilities, during rotor blade and fuselage design, blade tracking adjustments, and active flight control. The sensors act as mechano-electrical transducers to convert air flow-induced tangential surface forces into electrical output signals. They are thin and surface-mounted so cause minimal interaction with the flow, are easy to apply as an appliqué, and require no cavities or recesses other than holes to connect the sensor leads to data acquisition wiring. The material is resistant to normal aircraft fluids and solvents, can operate over a temperature range of -65 to +150C, and is capable of withstanding moderate rain and dust erosion. During Phase II, NanoSonic will Develop an improved understanding of the operation of thin film Metal Rubber<sup>TM</sup> skin friction sensors, Standardize sensor design and sensor fabrication processes, Develop a method to calibrate sensor elements as part of manufacturing, Develop a means to compensate for cross-sensitivity effects, Develop and optimize means for data acquisition, Use developed sensors in cooperation with the NASA LaRC Subsonic Rotary Wing program to investigate rotorcraft research and development problems, and Use and demonstrate the sensors in cooperation industry and academic colleagues. The significance of the proposed NASA Phase II SBIR program is in transitioning these sensors from analytical and FEM modeling to commercial products for experimental use by NASA and industry.

## Anticipated Benefits

Potential NASA Commercial Applications: Non-NASA applications of Metal Rubber

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'sensor skin' arrays include 1. measurement of skin friction during the research and development of advanced commercial aircraft and hydrocraft by universities, industry, and other non-NASA government agencies, 2. instrumentation of air and water flow as part of industrial process control, 3. measurement of flow effects in energy production systems such as wind and water-driven turbines, and ocean wave-based electrical generators, 4. instrumentation in environmental monitoring, such as determination of air flow interactions with buildings and bridges, and water flow interactions with levies, and erosion control rip-rap, and 5. tactile sensor arrays to measure and map



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## Table of Contents

Project Introduction	1
Anticipated Benefits	1
Primary U.S. Work Locations and Key Partners	2
Organizational Responsibility	2
Project Management	2
Project Transitions	3
Technology Maturity (TRL)	3
Technology Areas	3

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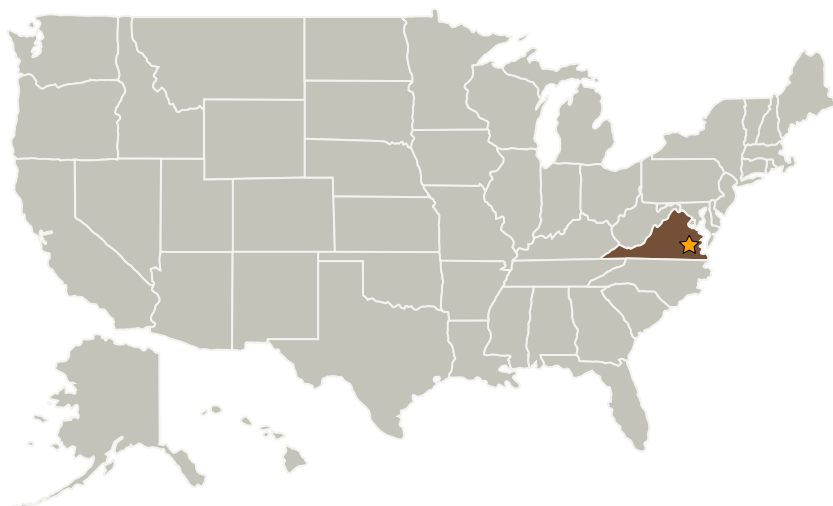


forces in biomedical prostheses. Additional applications of Metal Rubber

TM

materials themselves include as lightweight replacements for conventional tin-lead solder for the mechanical, electrical and thermal interconnection of electronic and mechanical components, in high performance, highly flexible, mechanically robust and lightweight electronic flex circuits, flexible displays and smart electronic fabrics, as low modulus conducting electrodes for high strain mechanical actuator and sensor devices, such as in medical prostheses, and as low-weight, electrically conductive and mechanically flexible coatings for systems requiring physically-robust electromagnetic shielding or ground planes.

## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia
Nanosonic, Inc.	Supporting Organization	Industry	Pembroke, Virginia

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Center / Facility:**

Langley Research Center (LaRC)

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

Carlos Torrez

**Project Manager:**

Luther N Jenkins

**Principal Investigator:**

Richard O Claus

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## Primary U.S. Work Locations

Virginia

## Project Transitions

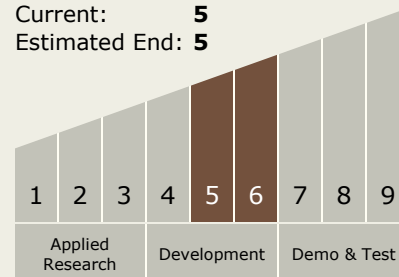
 **December 2009:** Project Start

 **March 2012:** Closed out

**Closeout Summary:** Metal Rubber Sensor Appliquis for Rotor Blade Air, Phase I  
I Project Image

## Technology Maturity (TRL)

Start: **6**  
Current: **5**  
Estimated End: **5**



## Technology Areas

### Primary:

- TX15 Flight Vehicle Systems
  - TX15.2 Flight Mechanics
    - TX15.2.3 Flight Mechanics Testing and Flight Operations